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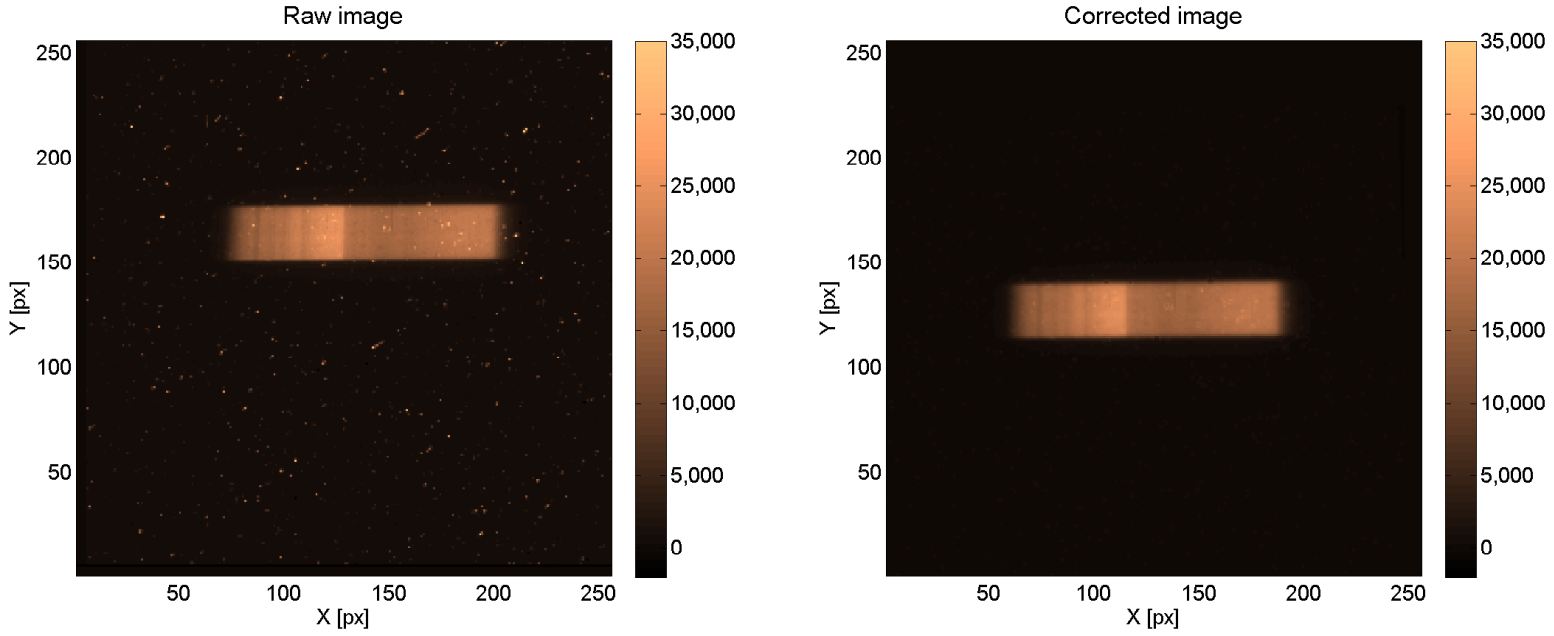
Atmospheric reconnaissance of the habitable-zone Earth-sized planets orbiting TRAPPIST-1

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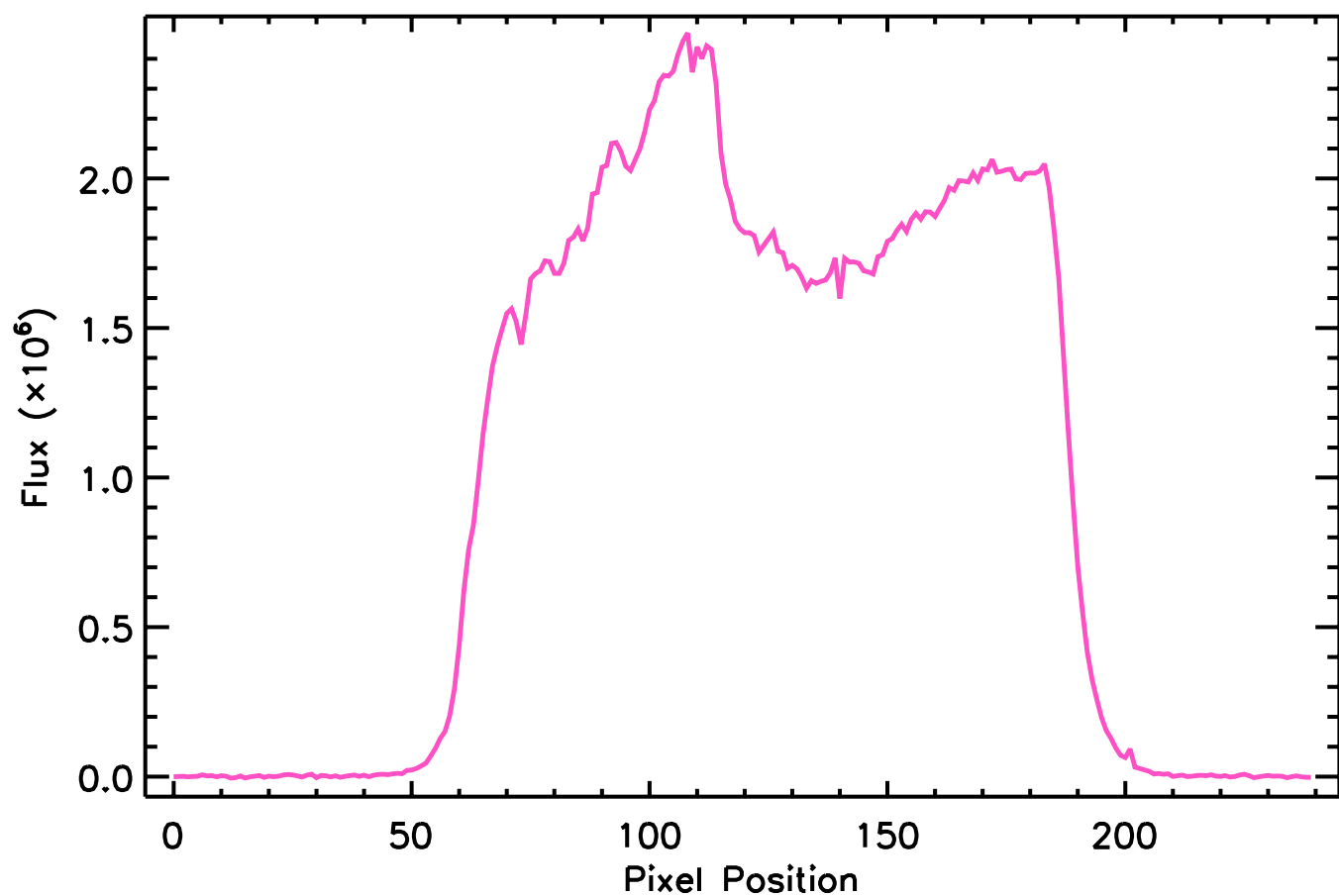
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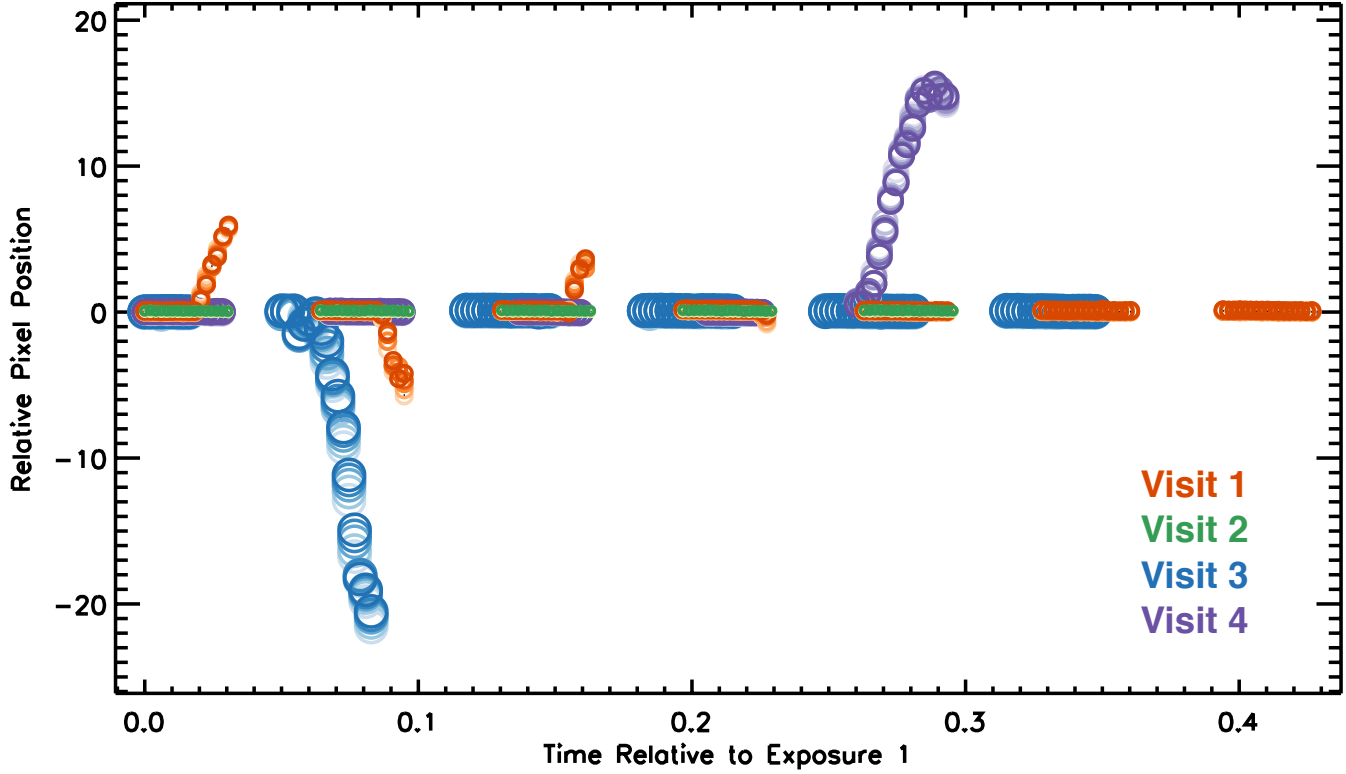
Supplementary Information



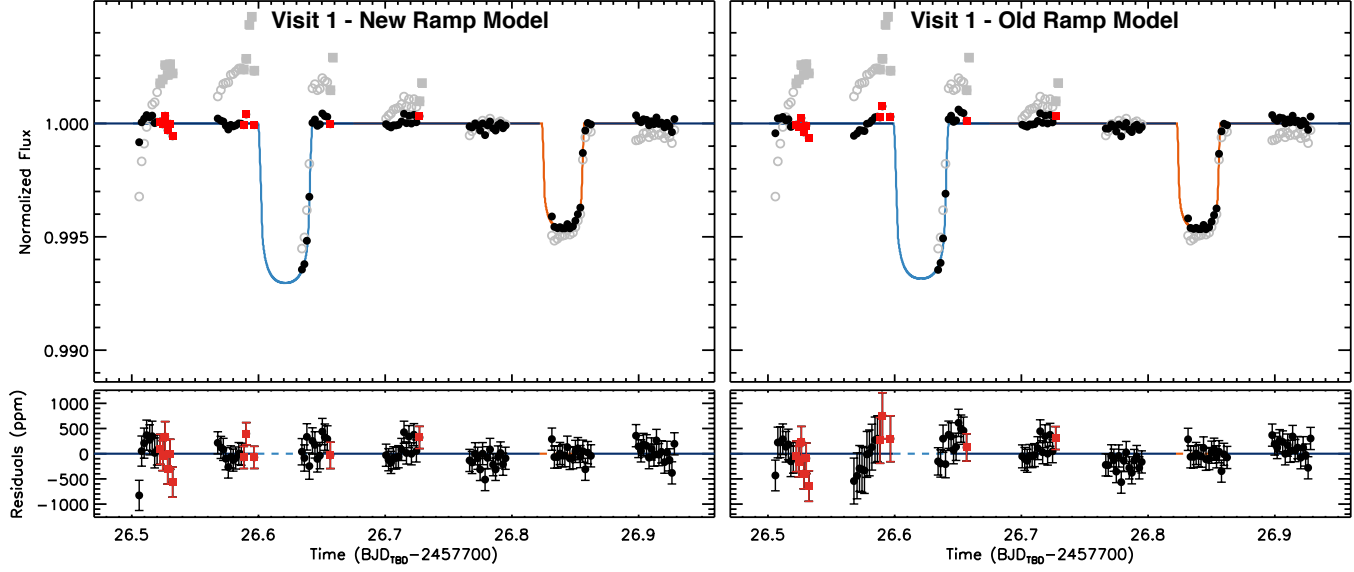
Supplementary Figure 1: Effect of SAA crossing on HST/WFC3 exposures. Left: Raw IMA frame corresponding to the exposure 56 of visit 4 (e56V4) taken during SAA crossing in GYRO mode, showing the increased cosmic ray interference and ~ 2 pixel positional shift in the dispersion direction from the bottom to the top of the scan. The frame exhibits a high level of cosmic ray hits and a slanted spectral trace. Right: Corrected IMA e56V4 frame.



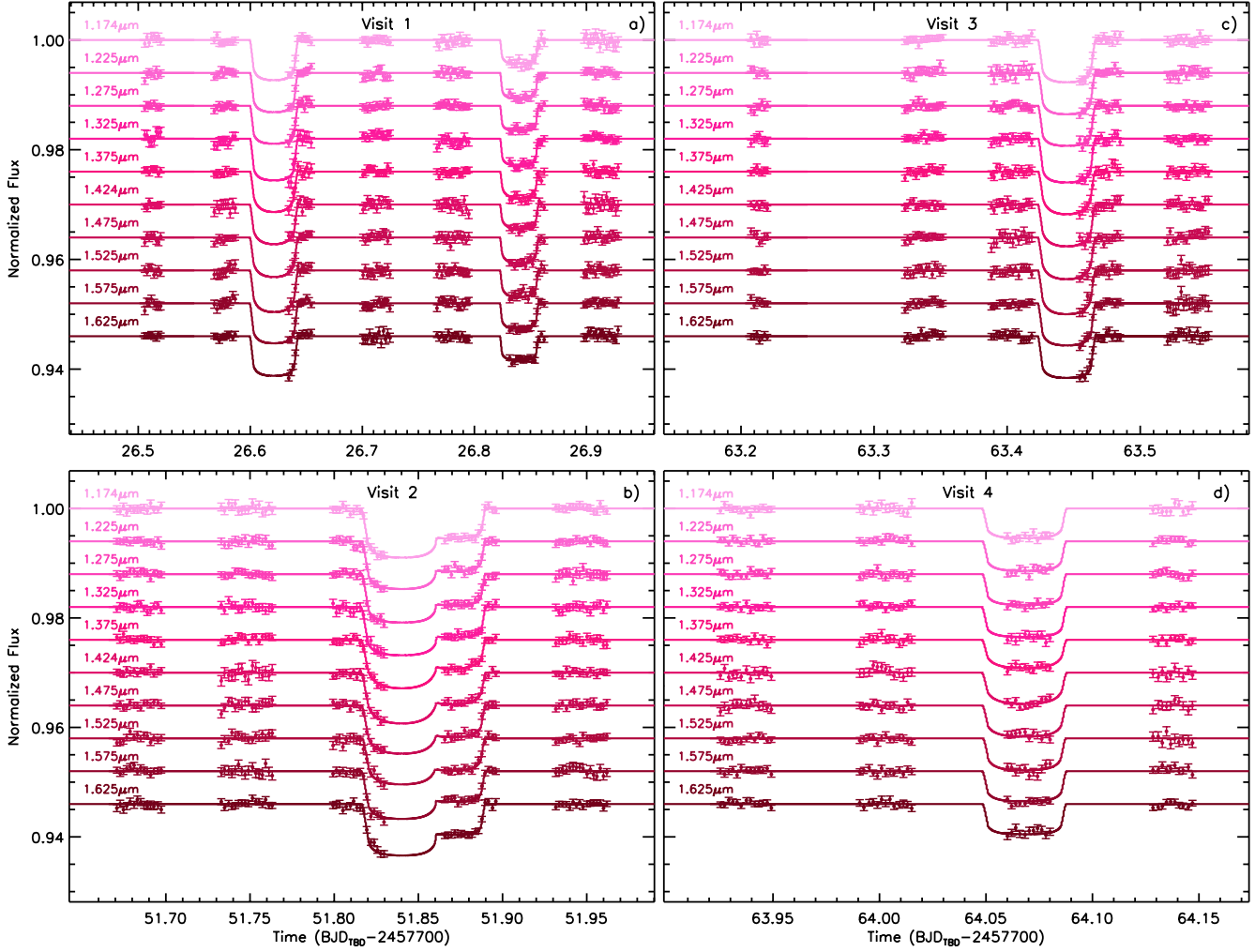
Supplementary Figure 2: Near-infrared spectrum of TRAPPIST-1 as observed with HST/WFC3/G141. The flux unit is electron count per exposure and the spread along the x axis corresponds to 4.6 nanometers per pixel.



Supplementary Figure 3: Motion of the spectral trace in the dispersion direction on the detector. Pixel position of the spectrum for each read of each exposure (light to dark circles) in each visit, relative to a template spectrum made from the first read of the last exposure for each visit. The large pixel shifts show where HST entered GYRO mode prompted by an SAA crossing. The gaps are caused by the occultation of TRAPPIST-1 by the Earth. Visit 1 (orange) entered GYRO mode 4 times over the course of the observations. Visit 2 (green) did not enter GYRO mode. Visits 3 (blue) and 4 (purple) entered GYRO mode once during the visit over the course of an entire orbit, each coinciding with a planetary transit.



Supplementary Figure 4: A new ramp model for HST/WFC3. Hubble/WFC3 white light curves of visit 1 corrected using our new time-dependent ramp model (left) and the standard time-independent ramp model (right). The quantities reported are the same as in Figure 1. The inability to correct for the ramps of orbits 2-7 using a unique ramp—as is typically performed—is revealed by the progressively decreasing slope in the residuals of orbits 2 and 3 in the bottom right panel. Our model can correct for the amplitude and time-scale decrease of the ramp thereby correcting the ramp effect seen across all the orbits of a visit with a unique and inclusive model.



Supplementary Figure 5: Hubble/WFC3 spectrophotometry of the four TRAPPIST-1 habitable-zone planets—TRAPPIST-1 d, e, f, and g—over four visits. Normalized and systematics-corrected data (points with their 1σ error bars) and best-fit transit model (solid line) in 10 spectroscopic channels spread across the WFC3 band, offset for clarity (channel-averaged $\text{SDNR} = \sim 520$ p.p.m.). The discarded measurements (notably the second orbit of visit 3 and the fifth orbit of visit 4) are not shown for clarity.